

Managing
**YOUNG
DAIRY
STOCK**
in California

S. W. MEAD and MAGNAR RONNING



A well-planned calf-raising program produces normal, healthy heifers.

This circular discusses the general fundamental principles for successful raising of dairy calves. It also describes a few specific methods which, with slight alterations, may be adapted to various ranch conditions. Although the method for a given locality or even for a given ranch is determined largely by cost of feeds available and the selling price of milk and cream, successful calf raising actually depends less on the method than on the fundamental principles of its application.

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IT IS INCREASINGLY difficult to maintain and improve a dairy herd by purchasing milking cows. With purchased stock the dairyman is unable to follow an intelligent breeding program that will permanently improve the inherent productive capacity of his herd; he is also in constant danger of introducing infectious diseases, which would jeopardize the health of his herd and might also prohibit the sale of milk. For the average dairyman, therefore, herd improvement in milk production and protection against disease must come through a well-planned breeding program. This means the raising of normal, healthy female calves (see photo page 2) sired by a carefully selected bull. Rigid attention must be given to all details of a sound calf-raising program.

COSTS, SELECTION, FEED AND MANAGEMENT

Cost is an important consideration in a management program for dairy calves. There is no definite information on the cost of raising dairy heifers. The price of feeds and other expenses vary too much throughout the state to serve as a stable basis for cost prediction. You may, however, estimate closely by applying local prices to the recommendations in this circular.

SELECTION OF CALVES

The life span of the average dairy cow is between five and six years. With most cows calving at a little over two years of age, the productive life is at best not more than four years. This means an annual loss from the milking herd of approximately 25 per cent. With an anticipated but variable calf mortality you should plan to save at least three calves for every 10 cows in the herd in order to keep the milking herd at constant size.

However, if you have a sound breeding program, you will save all calves and cull the poorest ones on the basis of their performance during the first lactation. This practice makes it possible to prove sires more accurately and, at the same time, determine definitely the productive capacity of each animal which remains in the herd. Any attempt to select at the time of birth the calves that might develop into the highest-producing cows is hazardous and will confuse results in estimating the transmitting ability of the sire.

Since low production is the biggest single reason for removing cows from your herd, use only the best available sires. California Napnick Ned (Bull 755A) shown on page 4—a bull bred and owned by the University of California—has had only a few daughters that would need to be culled because of low production (see chart on page 5). Reducing the number of culls decreases replacement cost, increases average production for the herd, and thereby reduces production cost.

While low-producing cows can often be purchased for less than the cost of raising them properly from birth, high producers can seldom be purchased at any price. Dairymen should give less thought to the cost of raising a calf and more to the selection of breeding stock and to more rapid growth through better feeding methods. The return on investment will be greater through earlier maturity and heavier milk production.

The freemartin. At least 90 per cent of the female calves born twin to a male are sterile. These are called freemartins. All other twin calves may be raised with the assurance that twinning has not impaired their breeding powers.

FEED AND MANAGEMENT FOR MAXIMUM GROWTH

Inheritance determines the amount of milk a heifer can produce, but unless she is properly fed and cared for she will be unable to reach her maximum inherited capacity.

Studies carried on at the Agricultural Experiment Station, Davis, prove the close relationship between body size at the time of first freshening and the amount of milk a heifer will produce. The table on page 5 shows the milk fat records of daughters of 11 bulls. Each bull was used in two or more herds. Hence, there was opportunity to compare each bull's daughters in two or more herds on the basis of known methods of feeding before first freshening.

The most striking difference in production is between the daughters of these 11 bulls in herds No. 1 and No. 2 and the daughters of the same bulls in any of the other herds. In some instances the differences are nearly 100 pounds of milk fat. There is unmistakable evidence that the difference in production was due to the much smaller size and poorer condition of the heifers at the time of first freshening in herds No. 1 and No. 2 than in the other herds. Production was greatest in the herds maintained with the best feeding and management methods.

California Napnick Ned (Bull 755A) is an example of a well-selected herd sire. The chart on page 5 shows the milk fat records of his daughters.

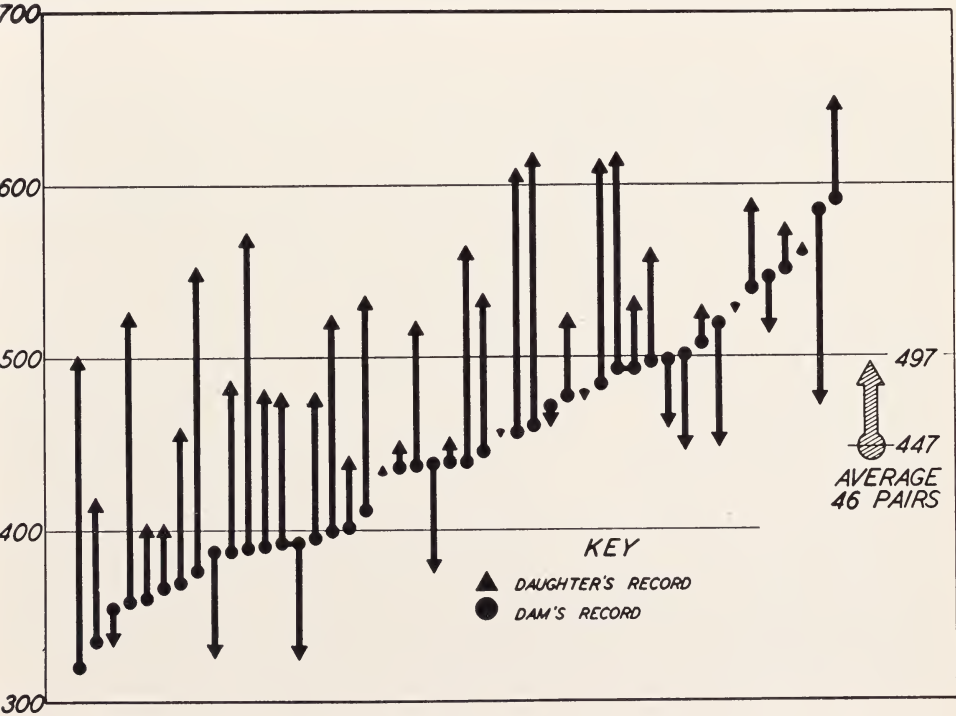


Heifers raised in different herds, but sired by the same bull, show marked differences in producing ability due to size and finish at time of first calving.

Sire number	Herd number								
	1	2	3	4	5	6	7	8	9
	Heifers' producing ability* (pounds milk fat)								
62A	316	...	369	376	386	...	...	...	...
333C	277	...	...	...	...	374	...	375	...
370A	365	...	...	...	...	456	435	448	...
372A	284	312	...	380	...	...	...	374	...
372B .....	...	297	...	347	...	...	...	...	...
372C	302	320	...	361	...	384	...	...	...
374B .....	...	280	...	316	...	...	...	...	369
375B	297	...	...	...	...	380	...	...	362
375E .....	...	296	336	...	...	...	...	389	...
498B .....	...	286	308	348	...	...	...	...	...
572B .....	...	387	379	...	...	...	...	441	472

* All records are for junior two-year-olds; 305-day lactations; twice daily milking.

Milk fat records of the daughters of the bull shown on page 4, compared with those of their dams. Only a few had to be culled because of low production. All records are for junior two-year-olds on 305 days lactations, milked twice daily.



HANDLING THE YOUNG CALF

The normal calf is born with a strong stimulation to grow unless certain factors—especially disease—discourage its normal development.

PROVIDE SANITARY CALVING STALL

A sanitary calving, or maternity, stall is preferable to any other calving site, for here the cow and calf can be watched closely. Many calves presumably born dead could have been saved had an attendant been present. For instance, a part of the fetal membrane often covers the mouth and nostrils; unless someone is present to remove this the animal will suffocate. Mucus in the mouth and throat, if not removed, may also cause suffocation. If the calving stall is not thoroughly sanitary, or if infectious calf diseases are prevalent, in good weather allow the cow to calve in a clean pasture. Certain infectious diseases have often been averted in this way.

Disinfect navel cord, which is a ready channel of infection, immediately after

birth. Empty the cord by grasping it between thumb and forefinger at a point near the calf's body and pressing downward toward the end. Then paint the cord and a small area around it with tincture of iodine or with some other suitable disinfectant.

Mark for identification before removing the calf from the dam. There are two methods of marking the calf for identification—tagging and tattooing.

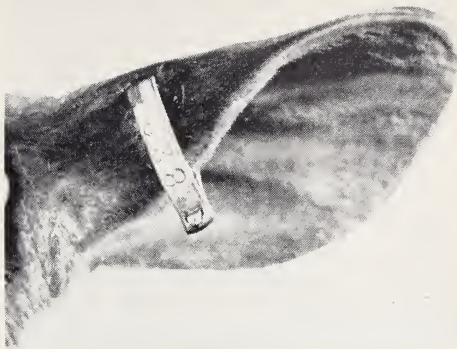
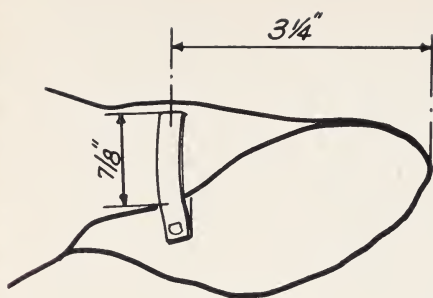
A tag bearing the herd number may be fastened to a strap around the neck. After the first calving remove this tag and insert a small tag in the ear. Or insert the ear tag immediately after birth, without first using the strap tag. In trials at the University of California Agricultural Experiment Station, calves were ear-tagged shortly after birth and up to approximately one month of age by placing the tag $\frac{3}{4}$ to $\frac{7}{8}$ inch from the upper edge and $3\frac{1}{4}$ inches from the tip of the ear (see illustration on page 7).

On older calves increase the measurements in proportion to the growth of the ear.

Do not let the tag pinch the ear at an



The normal healthy calf is born with a strong stimulation to grow.



The correct method of applying an ear tag. The measurements shown should be increased in proportion to the size of the ear.

spot, for this will shut off the circulation and cause a bad sore. *Do not cut through the ribs of the ear or it will be deformed.*

Tattooing is satisfactory for Jerseys, Guernseys, and Ayrshires, but is seldom visible in the black ear of a Holstein even when red ink is used instead of black.

The necessary equipment for tattooing may be obtained from livestock supply companies. Prepare the ear by wiping it clean and removing all waxy secretions on the inside surface with a cloth moistened with gasoline or other fat solvent. Then wipe off the solvent—the tattoo ink will not “take” on a waxy or oily surface. Apply a generous amount of ink—black for light ears and red for black ears—to the numbers or letters to be used and to the surface of the ear. Hold the ear between the thumb and fingers while puncturing and push it away from the points of the instrument as you release the pressure. *Immediately rub the ink into the puncture.* If properly done (see photos on page 8), the tattoo should last throughout the life of the animal.

Examine the ear when the calf is one year old. If the numbers are not clear, tattoo the other ear.

Dehorning. Prevent horns from growing rather than removing them after they have developed. One common way of preventing horn growth is to treat the rudimentary horn (horn button) with a

chemical such as caustic potash, which comes in stick form and can be purchased at any drug store. Before applying the caustic, be sure to wrap the hand end of the stick in paper to prevent finger burns.

The treatment should be given before the calf is three days old. Clip the hair from an area about 1 inch in diameter over the rudimentary horns, which can be felt beneath the skin. Spread a small amount of heavy grease around the outer edge of this area to keep the caustic from running into the eyes. *Do not allow caustic potash to run into the eyes, or the animal will be permanently blinded.*

Place the calf on its side and hold its head firmly against the ground. Rub the end of the caustic stick on the surface immediately over the horn until the hair is removed and the skin becomes red. *Be careful not to cause bleeding.* Repeat the process on the other horn, then place the calf in a pen alone for at least a day. *Do not turn the animal out in rainy weather.* Rain will wash the caustic into its eyes in spite of the grease ring. If the work is performed correctly, horns will not develop; if you were careless in this treatment, scurs or crooked horns will develop to mar the animal's head. The photos on page 9 show the various steps



Tattooing calves:

A: Remove the oily secretions.

B: Smear the ear and stamp points with tattoo ink.

C: Imprint the tattoo.

D: Rub the tattoo ink into the punctures.

E: The tattoo should be a permanent method of identification.





Dehorning calves:

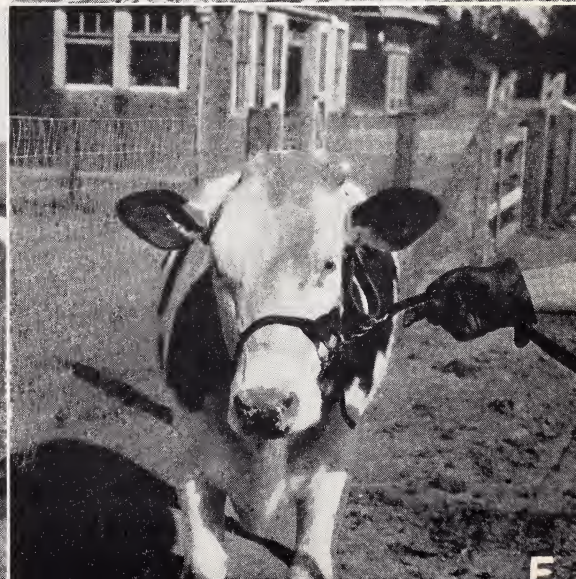
A: Clip hair from the rudimentary horn and surround the horn with a grease ring.

B: Apply caustic.

C: Treatment has completely destroyed the horn cells.

D: Correctly performed dehorning gives a natural polled appearance.

E: Careless dehorning leaves the animal's head deformed.





Dehorning with electrically heated iron.

in the dehorning process and specimens of properly and improperly dehorned calves.

Another satisfactory method is use of an electric dehorner. (See photo on page above). A specially designed electrically heated iron is placed over the horn button; the heat will kill the growth cells of the rudimentary horn. You must apply the heat long enough until the tissue around the base of the horn button becomes a deep copper color.

Some dairymen gouge out the horn button. This is not recommended, since it causes excessive bleeding and invites serious unnecessary infections.

If a preventive was not used to stop the growth of horns, they may be removed with horn clippers or saw. Do not use clippers or saw until the animal is 18 months of age, however, for at this age the horns will not regrow. Dehorn in winter to avoid contamination by flies. *but in rainy weather keep the animal*

under cover until the horn wounds are entirely closed.

Remove extra teats. Frequently calves are born with more than four teats. Remove these extra teats before the calf is six months old. At this early age the operation will not be difficult. Examine the teats to see that no abnormality is present, apply iodine to the area, clip close to the udder with sterilized scissors, then apply iodine to the wound.

FEEDING AND MANAGEMENT DURING THE FIVE EARLY STAGES OF GROWTH

The growth of the dairy heifer from birth to first calving falls naturally into five stages. The two days after birth constitute the first, when colostrum is the first food. During the next stage, extending through the second week, the calf should get its start in life on whole milk. In the third, from two weeks to six months, the change is usually made from whole to skim milk or to one of the minimum-milk methods discussed on pages 12 and 13. This stage carries the calf past the stage of greatest mortality. A calf normal at birth, properly managed to this age, presents a relatively simple problem during the fourth stage—from six months to one year—demanding only good judgment. This is also true of the fifth stage, from one year to first calving.

FROM BIRTH TO 48 HOURS

Colostrum, first milk. The normal calf will usually stand alone and attempt to nurse within an hour after birth. If it fails to do this, it should be given assistance. A generous feeding of colostrum, the mother's first milk, is *extremely important* to the calf. This milk is especially suitable for nourishing the newborn calf, and contains substances that aid the calf in resisting disease during early life. Experiments have shown a high death rate among calves not receiving colostrum.

Should colostrum not be available

from the dam because of illness or of having been milked before calving, use surplus colostrum from other cows which has been frozen previously in a deep-freeze chest. Colostrum may be frozen in ½-gallon milk cartons. Do not thaw frozen colostrum at temperatures above 145°F, or it will coagulate.

After 36 to 48 hours the calf has had enough colostrum so that it may be removed from the dam. At this early age teach it to drink by allowing it to suck the fingers in a pail of milk; then gradually draw the fingers away. After a few trials the calf will usually drink readily. Be patient and persevering in teaching a calf to drink. In stubborn cases (and only as a last resort) withhold feed for 24 hours, until the calf becomes very hungry. Nipple buckets or bottles eliminate the need to teach a calf to drink but it may be difficult to keep the equipment clean and sanitary.

FROM TWO DAYS TO TWO WEEKS OF AGE

Feed whole milk first two weeks. Properly supplemented with concentrates and roughage, whole milk cannot be surpassed for producing maximum growth. Dairymen producing market milk, however, find whole milk too expensive for the raising of calves except when it is used with one of the so-called minimum-milk methods (see page 13). Calves being raised for sale or show, where excellent condition is desired, will benefit by receiving liberal amounts of whole milk.

Regardless of the feeding method to be used, feed whole milk at least for the first two weeks of life. Small or weak calves require milk longer.

Do not overfeed. The stomach of the young calf cannot handle large quantities of food. Overfeeding—a mistake often made in an effort to induce rapid growth—causes indigestion, indicated by scouring (diarrhea), which seriously retards growth. Do not feed milk to the

limit of the calf's appetite. Sudden changes in either quantity or quality are disastrous. Measure the milk accurately for each calf—you may, for instance, use a spring scale fitted with a hook on which to hang the pail.

Amounts to feed daily vary with animal size, vitality, and fat content of the milk. A large, strong, healthy calf may safely be given twice as much milk as one underweight at birth. Milk containing a high percentage of fat should be fed in smaller amounts than low-test milk.

During the first few days give the calf a relatively small amount of milk, and gradually increase this daily. At the Agricultural Experiment Station at Davis, under a minimum-milk feeding plan, Jersey calves receive 3½ to 4 pounds of milk daily during the first 10 days after they are removed from the dam at two days of age; Holstein calves receive 4½ to 5 pounds daily, according to their size. Both breeds receive Jersey milk of a high fat content. If they were receiving Holstein milk, these amounts would be increased about a pound.

As a general rule, during the first 10 days feed milk at the daily rate of about 7 per cent of the calf's body weight. Later, increase this to 10 per cent. At no time is it necessary to feed more than 12 or 14 pounds of either whole or skim milk. Concentrates and roughage should be available at all times. California heifers are usually undersized at their first freshening, largely because they do not receive concentrates soon enough or in large enough quantities.

Number of daily feedings. Some dairymen believe that calves should be fed three to four times daily during the first two or three weeks. However, during the past 20 years at the Agricultural Experiment Station, calves have never been fed more often than twice daily, and the results have been very satisfactory.

Quality of milk. The milk should always be sweet and clean and, for the

first two months, should be fed at 90° to 100°F, as determined by a thermometer. For older calves the milk need not be quite so warm or so uniformly the same temperature at each feeding. It should never be fed cold, however.

Provide individual pens during the first one to two months as a precaution against spread of the diseases that come in the early life of the calf (see section on sanitation and calf quarters, page 24). Later, place calves of the same age together in a community pen provided with stanchions in which they may be fastened during milk feeding to assure each a proper amount of milk. That also makes possible the feeding of concentrates immediately after the calves have consumed their milk, which helps prevent their forming the habit of sucking each other.

Provide clean drinking water. Where calves are being raised on one of the minimum-milk methods supplemented with a dry calf starter, water is especially essential because of the reduced amount of milk fluid.

Feed concentrates and hay early. Except in the production of veal, make concentrates and hay available a few days after birth. Various concentrates and mixtures of these feeds, together with their use and the feeding of roughages, are discussed under the various calf-feeding methods.

FROM TWO WEEKS TO
SIX MONTHS OF AGE

After having given the calf a good start on whole milk during the first two

to three weeks, you may use any of the following feeding methods.

Skim-milk feeding. As far as the animal's future development and usefulness are concerned, skim milk—after the first two weeks of whole milk—gives as good results as whole milk and is less expensive. Animals fed skim milk are not, however, so fat and sleek at six months as those fed whole milk. As the table below shows, the only appreciable difference between whole milk and skim milk is in the fat content. This is an important difference since milk fat supplies over twice as much energy as protein and sugar and contains the vitamin A so necessary for the growing calf. If you change your calves to skim milk before they are consuming daily at least 1 pound of hay that has retained its green color, supplement their diet with vitamin A (see page 17).

A concentrate mixture is especially important to supplement skim milk as it partially replaces the energy normally furnished by the fat of whole milk. The mixture may consist of rolled barley, rolled oats, cracked corn, or similar carbonaceous feeds. The ingredients should be of high quality and offered in a coarse form to make them palatable and thus induce the calves to consume large quantities for rapid growth.

Skim-milk feeding is not, as popularly supposed, the cause of "pot-bellied" calves. This condition will not occur if you supply concentrates and good-quality roughage in proper amounts. Contrary to common opinion, skim-milk foam is not harmful. *Carefully pasteurize skim*

Whole milk and skim milk compared as feeds.

Feeds	Water	Fat	Protein	Sugar	Ash
	Per cent				
Whole milk	87 1	3 9	3 4	4 8	0 8
Skim milk	90 5	0 1	3 6	5 0	0 8

milk obtained from another ranch to avoid the danger of introducing disease.

Minimum-milk methods. If only a limited supply of whole or skim milk is available, what are the minimum amounts necessary for proper growth and development? Innumerable methods of calf raising require relatively small amounts of whole or skim milk; but the fundamental principles are all similar.

With any of the minimum-milk methods the calves must be given a good start on whole milk during the first two or three weeks. The length of the minimum-milk-feeding period then varies from four to 13 weeks and the amount of milk varies from 350 to 700 pounds. Calves raised on the smaller amounts of milk will not be so fat and sleek as those fed on more milk.

Calves to be weaned between 30 and 70 days of age are given a special concentrate mixture beginning at seven to 10 days of age. The mixture, called a calf starter, contains a variety of cereals, by-product feeds, minerals, and vitamins.

The Cornell method. The feeding schedule for a minimum-milk method suggested by Cornell University, requiring approximately 370 pounds of milk, is shown in the graphs on page 14. The schedule is only a guide, because each calf must be fed according to its individual needs. The recommended *calf starter*, prepared in quantity, consists of the following ingredients:

FEED	POUNDS
Cracked yellow corn.....	389.5
Crushed oats	400.0
Wheat bran	300.0
Linseed meal	200.0
Dried skim milk	100.0
Soybean meal	280.0
Cane molasses	100.0
Alfalfa leaf meal.....	140.0
Brewer's yeast	60.0
Irradiated yeast	0.5
Ground limestone	10.0
Dicalcium phosphate, or steamed bone meal	10.0
Iodized salt	10.0
Total	2,000.0

Normally, you will find it impractical to obtain all the necessary ingredients for the calf starter given here. It should be prepared by a feed company.

The *growing mixture* referred to in the graphs on page 14 contains the following feed:

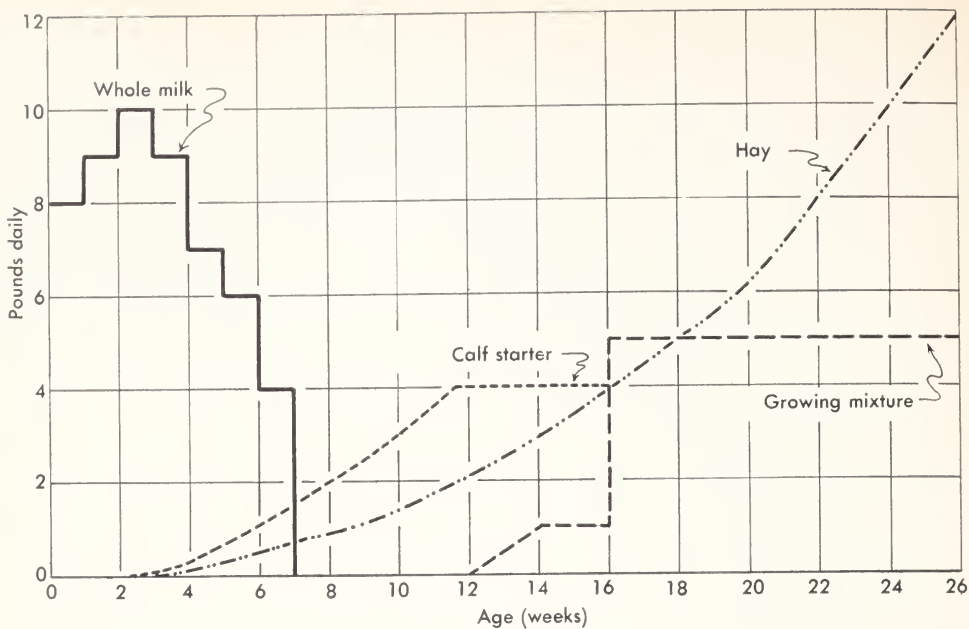
FEED	POUNDS
Ground corn	28
Ground oats	30
Wheat bran	30
Soybean or linseed meal.....	10
Steamed bone meal.....	1
Salt	1
Total	100

Barley, more common in California, can replace corn meal at this age since the calves should now be eating a sufficient amount of good-quality hay.

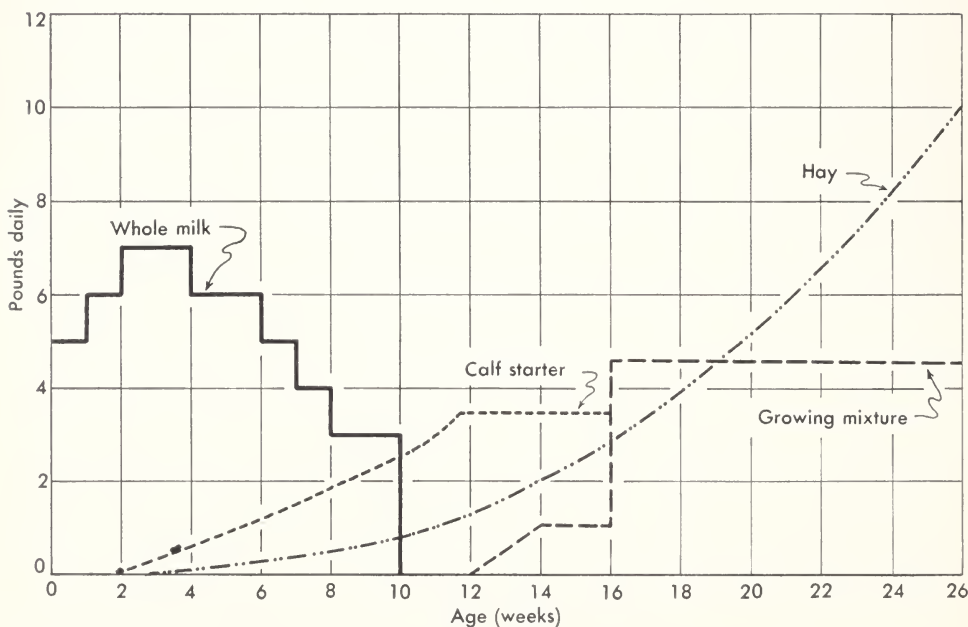
To raise calves successfully on a minimum amount of milk, you must get them to eat the calf starter at the early age indicated in the feeding schedules (page 14). Throw a small handful of the calf starter into the milk pail *after* the calf has finished drinking, and also rub a little into the calf's mouth. *Do not add calf starter to the milk.* Keep fresh calf starter and bright-green alfalfa hay before the calf at all times, until it is consuming the maximum amounts indicated in the feeding schedule.

The Davis method. A more liberal milk-feeding method requiring from 600 to 700 pounds of milk but a less complicated and less expensive concentrate mixture has been used successfully for a number of years at the Experiment Station, at Davis.

Whole milk is fed during the first two to three weeks; this may be followed by a gradual change to fresh or reconstituted skim milk, which is discontinued at 13 weeks of age; or whole milk may be fed during the entire 13-week milk-feeding period. On page 15 you will find the milk-feeding schedule, with average amounts of milk given for the 13 weeks. (The calf is left with the cow the first two or three days.)



Feeding schedules, using dry calf-starter method for Holstein-Friesian, Brown Swiss, and Ayrshire calves.



Feeding schedules for Jersey and Guernsey calves. (Drawings from New York State College of Agriculture, Cornell University.)

AGE IN WEEKS	POUNDS OF MILK FED DAILY	
	JERSEYS	HOLSTEINS
1	3.5	4.5
2	4.0	5.0
3	4.5	5.5
4	5.0	6.0
5	5.5	6.5
6	6.0	7.0
7	6.5	7.5
8	7.0	7.5
9	8.0	8.0
10	9.0	10.0
11	10.0	12.0
12	10.0	12.0
13	9.0	10.0

Increases from week to week are made gradually. After the first two to three weeks a gradual change may be made to skim milk, either fresh or reconstituted; if this is done, the amounts shown in the milk-feeding schedule should be increased somewhat. The amounts for Holsteins should be satisfactory for Ayrshires and Brown Swiss.

The calves are induced to eat the concentrate mixture at as early an age as possible. Usually the calves will begin to eat concentrates and hay in small amounts at seven to 10 days of age, although these feeds should be available to the calf soon after birth. Calves are allowed free access to both hay and concentrates until they are eating 5 pounds of concentrates. They are always allowed free access to hay. Fine-stemmed, bright-green, leafy alfalfa hay with its high content of protein, calcium, and carotene (pro-vitamin A) is best for calves.

With the Experiment Station minimum-milk method, calves six to 10 months of age did well on rolled barley and alfalfa hay or rolled oats and alfalfa hay.

The following *concentrate mixture* is used *while the calves are receiving milk*:

FEED	POUNDS
Rolled barley	40
Rolled oats	25
Wheat bran or millrun.....	25
Linseed meal	9
Salt	1
<hr/>	
Total	100

You may use the same concentrate mixture after the calves are weaned, although the addition of 18 pounds of dry skim milk or 10 pounds of white fish meal to this mixture after the calves are weaned will induce greater growth during the next three months. With fish meal, here is a satisfactory *mixture* for use *after calves are weaned*:

FEED	POUNDS
Rolled barley	35
Rolled oats	21
Wheat bran or millrun.....	21
Linseed meal	7
White fish meal	10
Soybean meal	4
Salt	1
Steamed bone meal	1
<hr/>	
Total	100

WHOLE-MILK SUBSTITUTES

Colostrum. This valuable food—the mother's first milk—is used immediately after the calf is born but may also be used at any time during the calf's life. It should not be wasted. It is normally rich in vitamin A, which is especially essential during the calf's early life. Experiments have shown that surplus colostrum not used during the first day or two of the calf's life, or colostrum produced by cows whose calves are not to be raised, may be fed to other calves at any age. It may be substituted for a like amount of herd milk or may be mixed with herd milk to make up the total amount needed in a day.

Dry skim milk is a satisfactory substitute for fresh skim milk when reconstituted in the proportion of 1 pound of dry skim milk in 9 pounds of water. The concentrate mixture given to calves weaned from liquid food at an early age can be improved through the addition of 15 per cent dry skim milk.

Fresh buttermilk and whey are satisfactory if strictly fresh and not diluted with wash water or condensed steam—which is sometimes done. These foods

should not be substituted for whole milk until the calf is at least four to six weeks old. Because of the greater acidity and laxative action of fresh buttermilk and whey more care is required in changing over to them from whole milk than from whole milk to skim milk. Since whey contains very little protein, the concentrate mixture should contain more protein than a mixture fed with skim milk. You will improve results if some whole or skim milk is fed along with the whey.

Commercial whole-milk replacers. A number of commercial whole-milk replacers are available. The most successful of the formulas tested usually contain about 60 to 80 per cent nonfat milk solids. Some formulas with less milk solids may be satisfactory if they contain relatively high levels of other high-quality ingredients such as blood flour, fish meal, soybean flour, and similar materials. These formulas should contain a source of vitamin A, as do the better products on the market.

All replacers, being relatively low in fat, may furnish only about two-thirds as much energy as whole milk. Some formulas contain added vegetable fats, but these fats must be hydrogenated to be tolerated by calves. At present, probably no more than 6 to 10 per cent (dry basis) of added vegetable fat can efficiently be utilized or tolerated by calves. Much work is being done to find ways of improving the utilization of vegetable fats in calf diets.

In feeding commercial whole-milk replacers, follow carefully and exactly the directions on the label. Feeding more than the recommended levels may cause serious digestive upsets. Feed a high-quality, high-energy starter along with replacers to supplement the energy intake of the calves. Such starters should not contain added vegetable fat if they are to be fed with replacers containing as much as 6 to 10 per cent vegetable fat. Calves cannot tolerate high levels even when vegetable fats are hydrogenated.

ROUGHAGES AND CONCENTRATES

Mixtures of grains, grain by-products, and other by-products of the oil and milling industries are often incorrectly called "grain mixtures." These should be called "concentrate mixtures." Such feeds as hay, pasture, forage, and silage are called "roughages"; they differ from the concentrates in greater bulkiness and usually in a higher percentage of fiber. Roughages vary considerably in protein content; and since they are generally the cheapest source of food nutrients, the basis for selecting a concentrate mixture depends largely on the roughage available.

Classes of roughage. Generally speaking, there are three classes of roughage. The first includes the high-protein roughages, or legumes, such as alfalfa, clover, vetch, cowpea and soybean hay, and green pasture. The second consists of the low-protein or carbonaceous roughages, such as the grain and grass hays and dry pastures and nonleguminous silages. The third, known as mixed roughages, contains any mixture of high- and low-protein roughages, such as alfalfa hay and corn silage; oat and vetch hay; or dry pasture, supplemented with a limited amount of a leguminous hay.

Suitable concentrate mixtures supply, at lowest cost, those characteristics and constituents in which the particular roughage may be deficient. They must of course be palatable, highly digestible, and provide variety, bulk, and common salt.

For best results, feeds such as barley, oats, wheat, milo, and corn should be rolled or crushed rather than finely ground. Calves prefer coarse feeds. Pelleting of calf starters, and even of growing mixtures, gives an advantage through greater consumption, more uniform mixing of ingredients, and less wastage.

MINERALS

Such minerals as calcium, phosphorus,

and iron are necessary for regulating the body processes and for developing the skeleton. Milk contains relatively large amounts of various minerals, which must come originally from the feed. An adequate supply of minerals is therefore extremely important for the rapidly growing calf and the high-producing cow.

Calcium and phosphorus are the minerals most frequently discussed. The legumes are particularly rich in calcium, whereas the concentrates are high in phosphorus and relatively low in calcium. Hence, calves and older heifers receiving generous amounts of a leguminous hay or pasture and of concentrates will have sufficient calcium and phosphorus. On the other hand, the grain hays and grasses are relatively low in both of these minerals. Concentrates will supply the phosphorus, and oyster-shell flour—added to the concentrates at the rate of 1 or 2 per cent of the mix—will supply the calcium. Range feed in the foothills and other nonirrigated pastures becomes leached and bleached as the season advances. Under such conditions, heifers should receive concentrates to supplement the phosphorus intake as well as that of protein, and total digestible nutrients. Feeding some hay may also be necessary. Some soils may produce mineral-deficient feeds. If this condition is indicated by bone chewing, wood gnawing, or any other form of depraved appetite, add to the concentrate mixture 1 or 2 per cent of a high-grade supplement, such as steamed bone meal or spent bone black.

Iodine. In certain restricted districts iodine deficiency is indicated by cases of "big neck" or goiter. Hairless pigs may also be found in such districts. However, the only area in California known to be deficient in iodine is a small area in Shasta County around Hat Creek. Pregnant cows in such areas should receive *stabilized* iodized salt to protect the calves they are carrying.

Salt. Make common salt available as soon as the calf begins to eat concentrates and hay. To each 100 pounds of concentrates add 1 pound of salt. In addition give the calf access to salt at all times, whether in the corral or on pasture.

Except as noted, mineral supplements are not necessary; nor are they, as many people believe, a cure-all for common ailments. Since complicated mineral mixtures are unnecessary and expensive, do not use them.

VITAMINS

Although several vitamins are needed by the calf for normal growth and development, these are supplied by natural feeds, such as milk from properly fed cows, fresh and dried green roughages, and sunshine.

Multiple-vitamin capsules or pills are unnecessary. The claim that such preparations will prevent or cure scours in calves receiving a normal diet is unfounded. There is no substitute for good feeding and management.

Vitamin A. Under conditions of improper nutrition, however, calves have been found to suffer from vitamin A deficiency. This is indicated by sore eyes (resembling pinkeye), weakness, unthriftiness, scours, and pulmonary complications. You can prevent such vitamin A deficiency if you make use of the natural feeds that are rich in this vitamin.

If the cow has received a normal ration of green hay or pasture during her dry period, her colostrum will contain far more vitamin A than at any other time during her lactation period. Since all calves are born with little or no reserve of vitamin A, be certain that the cow is properly fed before calving and that the calf receives the colostrum as soon as possible after birth. Calves receiving milk from cows fed bleached hay and no green pasture may require a vitamin A supplement until they are consuming enough hay of a bright green color.

Calves being raised on a minimum amount of milk or taken off milk at an early age may be benefitted by supplemental vitamin A.

Vitamin D. A deficiency of vitamin D can cause rickets or abnormal bone formation. Under most weather conditions in California no vitamin D supplement will be needed, since sunshine provides enough of this vitamin. Sun-cured hay is also a good source of vitamin D. This is another reason why calves should be taught to eat bright-green sun-cured hay at an early age. During the season of minimum sunshine, particularly along the coastal areas, it may be desirable to supply young calves with a vitamin D supplement until they are eating daily about 2 pounds of sun-cured hay.

If *vitamin A or D supplements* are needed, use commercial preparations. The vitamin content is given on the label in terms of International Units (I.U.) or in milligrams. Following are the daily recommendations for supplying vitamin A or its precursor (carotene) and vitamin D for each 100 pounds of body weight of the calf:

Vitamin A.....	7000 I.U.
or Carotene	4 mg
or Vitamin A alcohol.....	2 mg
or Vitamin A esters.....	2.2 mg
Vitamin D	300 I.U.

*FROM SIX MONTHS TO
ONE YEAR OF AGE*

Importance of hay and concentrates. After caring for the young heifers conscientiously from birth to six months, dairymen often make the mistake of assuming that the heifers can now take care of themselves. They give no concentrates during the pasture season and little more than roughage during the winter.

Many dairymen mistakenly suppose that grass is a perfect food for young stock. As a matter of fact, immature grass contains about 80 per cent water, and the digestive organs of a calf under 10 months of age are not capable of handling enough of this bulky food for

normal growth. One must therefore feed concentrates to keep the heifer growing rapidly. A heifer underweight at six months of age should receive somewhat larger quantities of concentrates. You can determine the amount to feed by weighing the heifer, or by estimating her weight by drawing a tape measure securely around her chest just behind the shoulders and elbows. See that she stands squarely on all four feet with her head in a normal position. The circumference of the chest in inches may then be compared with the figures presented in the table on page 19.

In those parts of California where the pastures dry up during the latter part of the summer, hay as well as concentrates must be supplied.

The poor growth made by dairy heifers turned onto dry, bleached pastures in summer is due to insufficient feed, particularly protein, and possibly calcium and phosphorus. Such pastures will also be low in vitamin A and may result in a deficiency, especially if the heifers have previously received a low-grade hay. The best supplement is a good-quality alfalfa hay (to supply protein, vitamin A, calcium, and part of the energy needed), and a grain such as barley or oats (to supply additional energy and phosphorus).

In winter, and when there is no pasture, the heifer six to 12 months old should receive her fill of the best-quality hay available, together with concentrates sufficient for normal growth.

*FROM ONE YEAR OF
AGE TO FIRST CALVING*

With cost the principal argument against raising dairy heifers, and the period from birth to first calving unproductive, the advantage of early calving is evident. To sacrifice size of animal for early calving is, however, a serious mistake. The undersized heifer, after freshening for the first time, is limited in her ability to produce milk by the fact that

Normal body weight and heart girth* of heifers during the growing period.

Age (in months)	Ayrshire		Guernsey		Holstein		Jersey	
	Weight (in pounds)	Girth (in inches)	Weight (in pounds)	Girth† (in inches)	Weight (in pounds)	Girth (in inches)	Weight (in pounds)	Girth (in inches)
Birth.....	72	29	65	28	90	31	53	27
1.....	89	31	77	30	112	34	67	30
2.....	119	34	102	34	148	37	90	33
3.....	158	38	133	36	193	40	121	35
4.....	198	41	173	39	243	43	158	38
5.....	245	43	216	41	297	46	199	41
6.....	293	45	260	43	355	49	243	44
7.....	344	48	305	46	410	51	286	46
8.....	389	50	350	48	462	53	324	48
9.....	433	51	389	50	509	55	360	50
10.....	469	53	427	51	552	56	393	52
11.....	502	54	459	53	593	58	420	53
12.....	538	56	490	54	632	59	450	54
13.....	577	57	524	55	671	60	479	55
14.....	611	58	556	57	705	61	507	56
15.....	638	59	584	58	746	63	530	58
16.....	669	60	605	59	782	64	558	59
17.....	697	61	634	59	809	64	580	60
18.....	725	61	663	61	845	65	601	60
19.....	758	61	686	61	878	66	622	61
20.....	793	63	712	63	912	67	642	62
21.....	818	63	737	63	952	68	665	63
22.....	844	65	763	64	986	69	684	64
23.....	871	65	788	64	1,024	70	708	65
24.....	902	66	818	66	1,069	71	733	65
27.....	909	68	876	67	1,151	74	816	67

* Data from: Ragsdale, A. C. Growth standards for dairy cattle. Missouri Agr. Exp. Sta. Bul. 336:1-12. Reprinted 1942. (Heart girth measurements have been rounded off to the nearest inch.)
† Heart girth measurements for Guernseys have been adapted from Nebraska Agr. Exp. Sta. Res. Bul. 91:1-29. 1937.

she is still growing. *A cow cannot consume enough food for both maximum production and the growth that should have been made before first freshening.*

Obtaining normal growth. Growth is most economical when most rapid. It is accomplished more easily between birth and two years of age—when the animal’s urge to grow is strongest—than at any other period. Although the normally developed heifer at one year will do fairly well on good pasture alone, pasture feed usually becomes less abundant as the summer advances. The practice—all too common in California—of neglecting to

supplement such feed with concentrates or with first-class hay has resulted in a high percentage of undersized heifers.

In winter, or whenever pasture is not available, heifers between one year of age and first calving should receive, preferably, high-grade alfalfa hay, and depending on the heifers’ condition, from 3 to 5 pounds daily of either rolled barley, oats, ground corn, or the milking-herd mixture. Cereal silage, a very good feed for heifers of this age, may be substituted for part of the hay. In such a case, however, the heifers will not get enough protein; therefore a mixture is required

to supply the needed protein—30 per cent rolled barley and 20 per cent cottonseed meal, for example. If legume or grass silage is fed a protein supplement would be unnecessary. A still larger percentage of a protein concentrate will be needed if only low-protein roughages are fed, such as grain or Sudan grass hays. A mixture of 65 per cent rolled barley and 35 per cent cottonseed meal will suffice. In either case make available at all times a block of salt or a box of ground salt. Also, add 1 per cent of salt to the concentrate mix.

A survey of the calf-raising methods used by members of the State Dairy Herd Improvement associations explains why there are so many undersized heifers, especially at the age when heifers of normal size should be calving for the first time.

Experience has shown that growth cannot be normal on roughage alone, yet 40 per cent of the dairymen feed only hay as a supplement to milk. Fully 70 per cent of the dairymen wean their calves at an average of 5½ months of age, while 30 per cent wean at slightly under four months of age. Either method is satisfactory if sufficient concentrates, as well as hay, are fed. Fully 80 per cent of the dairymen turn their calves out to pasture before the animals are six months old; and approximately 50 per cent feed no supplements of any kind, either concentrates or hay, after turning the calves out to pasture. In other words, many of the calves raised in California apparently must depend on pasture alone after they are six months old. This method of raising dairy heifers will not permit normal growth, particularly when the dairymen feed no concentrates during the milk-feeding period.

Determining age of breeding. The survey also showed that 18 per cent of the dairymen who own Holsteins breed them at 12 to 15 months of age; 38 per cent, at 16 to 18 months; 25 per cent, at 19 to 21 months; and 19 per cent, at 22 to 27

months. Since the recommended age for breeding normally grown Holstein heifers is 18 to 20 months, nearly 65 per cent of the Holstein dairymen breed their heifers too young or delay beyond the normal age.

Opinions differ as to when a Jersey heifer should be bred. If she makes normal growth she is usually considered ready at 15 to 17 months of age. Many breeders, however, believe that body weight is a better index than age. For instance, if dairy heifers are underfed and therefore grow at less than the normal rate, it is poor management to breed such small animals so early. In contrast, some believing that the smaller animals are more refined in conformation than large animals, prefer to have their heifers calve before they get too large. No doubt this belief is true, but such heifers are almost invariably below normal in body size. Since body size is directly related to milk production, especially in first-calf heifers, this practice is probably not sound.

The survey of calf-raising methods shows that, of dairymen owning Jersey and Guernsey cattle, 40 per cent breed their heifers at 12 to 15 months of age; 38 per cent, at 16 to 18 months; 19 per cent, at 19 to 21 months; and 3 per cent, at 22 to 24 months. Since normally grown Jersey heifers may be bred at 15 to 17 months, nearly 60 per cent of these dairymen either breed their heifers too young or delay beyond the normal age. In view of the reports received on feeding methods, it is doubtful whether the heifers bred between 12 and 15 months are normal in size for their age. It is also doubtful whether the 22 per cent who breed their heifers at 19 to 24 months would delay breeding until this age if their heifers were large enough to breed at the customary age. It may therefore be safely said that about one-half of the members of the State Dairy Herd Improvement associations who replied to the questionnaire either are

wasting time in getting heifers into milk production or are producing numerous undersized first-calf heifers.

If you have abundant, cheap pasture, you may profitably feed only roughage and delay breeding until the heifers have reached the normal size for breeding. If you don't have abundant, cheap pasture, the increased cost of feeding concentrates up to eight to 10 months of age and of supplementing poor pastures with hay will be fully repaid by bringing heifers into milk production at an earlier age, unhampered by small size.

With growth so greatly affected by feeding conditions, therefore, *heifers should be bred according to body weight rather than age*. Here is the proper relation between body weight and breeding age *when heifers make normal growth*:

BREED	AGE TO BREED (IN MONTHS)	NORMAL WEIGHT (IN POUNDS)
Holstein	18-20	845-912
Ayrshire	17-19	697-758
Guernsey	16-18	605-663
Jersey	15-17	530-580

Normal growth data are not available for Brown Swiss cattle; they are commonly bred at about 21 months of age.

FEEDING AND MANAGEMENT BEFORE CALVING

Feeding. Fit the heifer for lactation two or three months before calving. During the first part of the lactation period the high-producing heifer cannot consume enough food to supply the materials needed to maintain a high level of milk production. Before calving, therefore, her body must store a reserve of food materials to draw on during this period of heavy production.

When good pasture is available, no additional roughage is needed. The amount of concentrates to be fed varies with the condition of the heifer. Usually it is well to start with about 2 pounds daily and increase in 10 days to 5 to 8 pounds daily. When no pasture is available, hay must be supplied. Apply the

feeds and feeding methods suggested under "From One Year of Age to First Calving," but increase the amounts of concentrates.

Management. Fasten the heifers in the stanchions with the milking herd for the feeding of concentrates. The feeder can then see the condition of each heifer and can feed more intelligently. The heifer will also form the habit of coming to the barn at milking time, and in this way will soon become accustomed to the surroundings. This will make her easier to handle after freshening.

At least a week before the calculated date of calving, watch the heifer closely: at the first sign of approaching birth give her a clean, comfortable place in which to calve. After calving, protect her from cold drafts and feed her lightly for the first few days. Later gradually increase the amount of concentrates until you have determined her potential producing ability, then feed concentrates in proportion to milk production.

Heavy feeding for early calving. Since the period between birth and first freshening is unproductive, the possibility of shortening this without sacrificing body size deserves investigation.

As shown by experiments at Davis, heavy feeding will increase the growth of Jersey heifers sufficiently for them to be bred four to five months younger than heifers making only normal growth. Heavily fed heifers received whole milk for the first three weeks and skim milk thereafter to three months of age. In addition, they had all the concentrates and alfalfa hay they would eat, from one week of age to the time of freshening, at an average of 22 months.

From one week to three months of age the following concentrate mixture was fed:

FEED	POUNDS
Rolled barley	400
Rolled oats	300
Wheat bran	300
Linseed meal	100
Salt	13

AVERAGE WEIGHTS OF HEIFERS (IN POUNDS)

AGE (IN MONTHS)	HEAVILY FED	STANDARD METHOD	NORMAL (TABLE ON PAGE 19)
Birth	57	54	53
6	336	274	243
12	584	489	450
18	806	648	601
22	906*	748	684

* Weight after freshening.

If other protein-rich feeds are more favorably priced they may be substituted for linseed meal. During the fourth, fifth, and sixth months, 18 per cent of dry skim milk was added to this mixture; but it was omitted during the seventh, eighth, and ninth months. From the tenth month to the time of freshening, at an average age of 22 months, rolled barley only was used to supplement the alfalfa hay. By the time the average heifer freshened, she had consumed 3,900 pounds of concentrates and 3,700 pounds of alfalfa hay; at this time no pasture was available.

The average body weights of the first 24 Jersey heifers raised by this program are compared above with heifers previously raised in the University herd.

Thirty-seven such heavily fed heifers have completed their first lactation. Calving at 22 months, they have averaged, under Advanced Registry supervision, 6,385 pounds of milk and 381 pounds of milk fat in 305 days. All were milked twice daily.

Had these heifers had access to pasture, the amounts of concentrates and hay would have been greatly reduced and the cost of raising correspondingly lowered. If, however, heifers are to be bred at this early age without sacrificing size, they must be heavily fed from birth to freshening. *Early calving without previous heavy feeding during the growing period leads to undersized heifers which cannot produce to the full extent of their inherited capacity.*

COMMON AILMENTS¹

Scours. The most common ailment of calves is scours, or extreme looseness of the bowels. Until proved otherwise, scours can either be infectious or noninfectious. So many variations and conditions accompany scours that this circular cannot discuss the subject in detail; only general recommendations can be made. Where losses persist, call a veterinarian for advice on prevention and treatment of the calves.

Noninfectious scours is usually due to digestive disturbances and may be caused by overfeeding, sudden changes in quantity or quality of milk, feeding milk too rich in fat, variations in temperature of milk, irregularity in feeding time, or feeding milk alternately sweet and sour. The trouble is more easily prevented than cured. A calf receiving a setback by scours can be restored to normal growth only with great difficulty.

Naturally not all attacks of scours are due to the same cause; often the cause is unknown. Few, if any, of the numerous advertised medicines for calf scours will cure all cases. It is unwise to depend on medicines to prevent losses.

At the first sign of indigestion or scouring, isolate the calf, withhold milk for a day, and gradually return to normal feeding. In addition, give one treatment of 2 to 4 tablespoons of castor oil in $\frac{1}{2}$ pint of mineral oil. This treat-

¹ This section has been read and approved by John W. Kendrick, associate professor, School of Veterinary Medicine, Davis.

ment may be followed twice daily with about $\frac{1}{2}$ ounce of bismuth subnitrate mixed with a very small amount of water until the calf is well.

Some dairymen add $\frac{1}{2}$ pint of lime-water to the milk fed to all calves at each feeding for the first month. Limewater is made either from unslaked lime or from commercial hydrated lime (plaster lime). Place a lump of unslaked lime the size of an egg or 2 ounces of commercial hydrated lime in a pail of water and, at short intervals, stir vigorously several times. When the lime has settled, use the clear solution. In some cases scouring has been controlled by pasteurizing the milk.

Certain outbreaks in calves under six weeks of age may be successfully treated by substituting warm barley water for milk for two days. On the third day feed equal parts of barley water and milk, and bring the animal gradually back to milk by the fifth to the eighth day. The barley water is prepared by boiling rolled barley in the proportion of 1 part grain to 5 parts water. The grain is then strained out through cheesecloth, and the liquid fed at a temperature of about 100°F. When the calves are hungry they drink it as readily as they do milk.

Infectious scours, often called "white scours," usually attacks calves at or shortly after birth and causes death before the end of the week. The symptoms are weakness, dullness, sunken eyes, and a profuse discharge of dirty or yellowish-white feces of a pasty or watery consistency with an offensive odor. Unless drastic measures are taken, every calf will be affected. Remove dead animals immediately and burn or bury them; burn the bedding and thoroughly disinfect all the quarters occupied by calf and cow, as well as adjacent surroundings.

On farms where scours has recently existed, clean and disinfect the maternity stall thoroughly before allowing the cow to enter for calving. Immediately

after calving remove all bedding and thoroughly clean and disinfect the stall again. After calving be sure to also wash the udder and teats of the cow with soap and water before permitting the calf to suckle.

Since the specific causes of infectious scours are unknown, the commercial antiserums and vaccines often recommended are rather unreliable as a means of combating this very serious illness.

The most successful method of handling an outbreak of infectious scours is to select an entirely new calving location (box stall or pasture) that has not been used by cows or calves for some time (see also section on sanitation and calf quarters, page 24). Move the cow to these quarters just before calving, and, with soap and water, thoroughly wash the external reproductive organs and the rear quarters. Then before the calf nurses, also wash the udder and teats with soap and water. Do not move the calf to the regular calf quarters until it is three to four weeks old, when the danger of scours is largely past. Too much emphasis cannot be placed on the value of two or more feedings of the mother's first milk—colostrum—in aiding the calf's resistance to the infectious diseases of early life.

Calf pneumonia causes heavy losses in calves. Susceptibility is greatly influenced by the conditions under which the animals are maintained. Resistance is lowered and the infection encouraged by overcrowding, dampness, poorly ventilated quarters, insufficient bedding, especially on concrete or stone floors, and exposure to extreme variations in atmospheric conditions. Calf pneumonia may follow an attack of scouring; or it may be entirely unassociated with scouring, being contracted by calves two to three months of age. Pneumonia is characterized by a profuse discharge from the nose, heavy breathing, and a considerable rise in body temperature. Calves showing these symptoms should be isolated.

blanketed, and placed in a dry, well-bedded pen away from drafts. Call a veterinarian immediately.

Use of sulfonamides and antibiotics. Certain of the sulfonamides and antibiotics such as penicillin, streptomycin, and aureomycin have been used successfully in treating some cases of scours and calf pneumonia. No recommendations for their use are made in this publication. Sulfonamides and antibiotics should be prescribed only by a veterinarian.

Lice. As a rule, dairy calves are not infested with lice during the summer and fall. In winter and early spring, however, they are often attacked, especially around the muzzle, eyes, withers, and along the back line. Control lice with rotenone or malathion, following the directions for their use on the container.

Pinkeye, or infectious keratitis is characterized by an inflammation of the membrane of the eye. The cornea finally becomes a hazy blue and eventually changes to an opaque milky white. Occasionally ulcers form on the cornea. Immediately isolate calves so affected in a shaded or dark area. Use penicillin ointment (ophthalmic) or a combination of antibiotics and sulfa drugs, especially prepared for treatment of pinkeye.

Ringworm. This infection of the skin is indicated by round spots of rough skin devoid of hair, commonly around the head, but occasionally also on other parts of the body. Without treatment, the disease tends to spread. Wash the spots with soap and water, scrape to remove all scaly material, and treat with tincture of iodine.

Lead Poisoning. Never use lead paints on buildings or on fences around yards where calves are confined. Such paints when consumed in any appreciable amounts are known to be poisonous and to cause death.

Brucellosis. The California State Law requires that all dairy heifer calves must be vaccinated between four and 12 months of age. Consult your veterinarian.

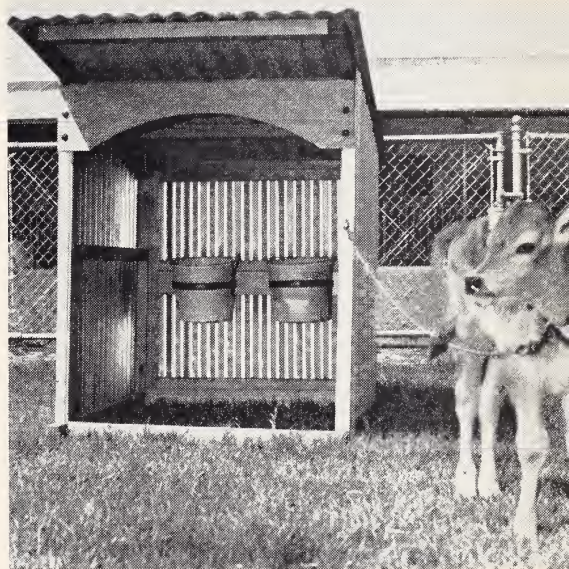
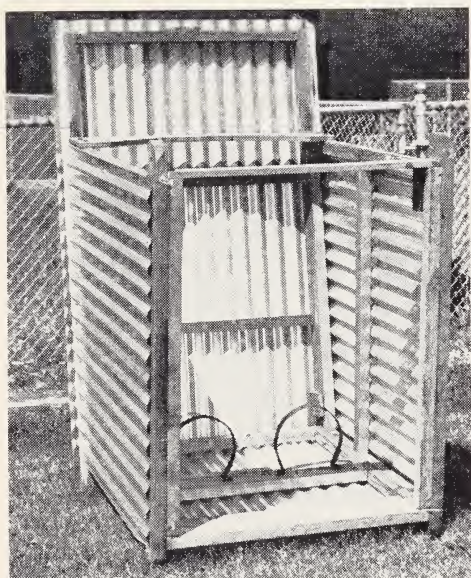
SANITATION AND CALF QUARTERS

Sanitation. Preventing infectious diseases is usually easier than curing them. Keep the calf quarters and feeding utensils scrupulously clean at all times. Give the quarters a very thorough cleaning at frequent intervals. Scrub the walls, partitions, stanchions, floors and mangers; then sanitize with a solution of hot lye or another strong disinfectant. When any calves appear to be even slightly abnormal, isolate them at once and have their condition carefully diagnosed, if necessary, by a veterinarian. If an infectious disease is suspected, consult a veterinarian immediately.

Calf quarters. It is unwise to invest in an elaborate barn for calves under two months of age. Several small structures, which may be moved readily and dismantled in an outbreak of infectious disease, are more suitable. Individual pens of this type placed so that calves will not come in contact with one another help to prevent the spread of diseases, materially reducing calf losses. Their use is now a common practice on many dairy ranches.

The type and number of such structures depend on climate and size of the herd. In most parts of California, temperatures are seldom low enough to make the calves uncomfortable. Give them quarters that are dry during rainy weather, and admit plenty of sunshine. While the type of structure may be varied somewhat to suit the local climate, that shown on the opposite page is being used successfully at the University of California, Davis.

Even when calf losses have not occurred, move each pen to new ground as soon as a calf has been removed, at four to six weeks of age. Most calf losses occur during the first month. The practice of moving the pens will reduce the hazard of infection from the previous calf. Even better, leave each pen unoccupied for a week or two. If the previous calf had any kind of sickness, scrape the entire pen



The type of individual calf pen shown on this page is being used successfully at the University of California, Davis.



free of all manure, scrub the inside walls and floors with lye solution, and leave the pen exposed to sunlight for a few days. Then move the pen to new ground away from the site of any infection.

A shed structure with community pens for grouping calves according to age is more suitable for calves over one month old. At least one of the community pens should be equipped with stanchions so that calves still receiving milk can be fed individually.

Plans for calf barns with both community and individual pens are obtainable from the Agricultural Extension Service, University of California, Davis.

RAISING THE HERD SIRE

Feeding and care of the future herd sire and the heifers are almost identical. During the growing period, however, the males should be fed liberally to induce maximum growth; otherwise the animal's inherited size cannot be judged. When the bull calf is between four and five months of age, separate it from the heifers. Continue to feed milk to five or six months of age. Feed liberally the concentrates and roughage recommended for heifers.

Well-grown bulls may be used in service once or twice a week from 12 to 13 months of age, and the number of services increased gradually thereafter.

VEAL PRODUCTION

Feeding for veal production. The methods used in hand-feeding the veal calf do not differ markedly from those used in raising the dairy calf for breeding, except as outlined below.

Whole milk alone, without supplements of grain or hay, is most satisfactory for producing the best grade of veal. Considerable experience is required for producing the most rapid growth without causing the calf to go off feed. As a rule, the one- to two-week-old calf will take approximately 1 pound of milk

per day for each 10 pounds of body weight. Later the amount of milk should be increased gradually according to the judgment of the feeder. Calves raised by nurse cows usually grow faster, with fewer digestive disturbances, than bucket-fed calves.

While whole milk alone is required for the production of best-quality veal, it may pay to feed calves to an older age for meat production if you have an abundance of skim milk. Supplement the skim milk with grain, such as rolled barley, rolled oats, or ground corn, and with good-quality hay. Such calves are then marketed at eight to 10 months of age.

Condition at marketing. Most veal calves are marketed between four and eight weeks of age. They are first classified according to weight and further classified as to conformation, finish, or smoothness of fleshing. Calves of 110 pounds or less are referred to as light weight, 110 to 180 pounds as medium weight, and more than 180 pounds as heavy weight. Vealers weighing 140 to 155 pounds and occasionally up to 180 pounds, which are marketed at six to eight weeks of age, are in greatest demand if they are well finished. The quality of the veal is the most important factor in determining the price the producer will get for his calf.

The beef breeds as a rule make the best veal; dairy calves often bring 1 to 3 cents less per pound.

Estimating profit or loss. While it is impossible to predict the future market price of milk or veal, the dairyman can determine for himself whether or not veal production will be profitable under his conditions.

The cost of raising veal to the desired weight is estimated on the calf's weight at birth and the requirement of about 10 pounds of whole milk per pound of gain. For example, a calf weighing 80 pounds at birth, to be marketed at 150 pounds, will require 700 pounds of whole milk (70 pounds increase in weight times 10

pounds of milk for each 1-pound increase in weight). Multiply this figure of 700 pounds by the market price of milk, and you will obtain the cost of raising the

calf, minus labor, equipment, etc. The difference between this figure and the market price of veal will show the profit or loss.

In order that the information in our publications may be more intelligible, it is sometimes necessary to use trade names of products and equipment rather than complicated descriptive or chemical identifications. In so doing, it is unavoidable in some cases that similar products which are on the market under other trade names may not be cited. No endorsement of named products is intended nor is criticism implied of similar products which are not mentioned.

Co-operative Extension work in Agriculture and Home Economics, College of Agriculture, University of California, and United States Department of Agriculture co-operating. Distributed in furtherance of the Acts of Congress of May 8, and June 30, 1914. George B. Alcorn, Director, California Agricultural Extension Service.

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